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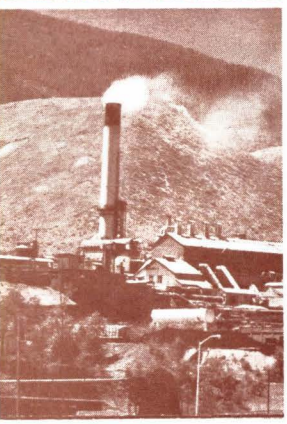

FOREST ENVIRONMENTAL PROTECTION

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EVALUATION OF MOUNTAIN PINE BEETLE INFESTATIONS, LAZIER AND MEADOW CREEK DRAINAGES, PLAINS DISTRICT, LOLO NATIONAL FOREST, MONTANA

1975

by

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ABSTRACT

Mountain pine beetle reached epidemic levels in the Lazier-Meadow Creek drainages on mixed ownership in 1972. A total of 118,486 trees with an estimated volume of 5,666,124 board feet was killed from 1972 through 1974. Presence of overstocked, mature, nearly pure lodgepole stands, coupled with favorable weather conditions, are believed to be responsible for outbreak development. Prompt salvage logging of infested and susceptible trees, and conversion to a mixed species stand, compatible with the designated habitat type and site index, are recommended to alter the course of the outbreak.

INTRODUCTION

Mountain pine beetle, *Dendroctonus ponderosae* Hopk., reached epidemic levels in lodgepole pine, *Pinus contorta* Dougl., stands in Lazier and Meadow Creek drainages in 1972. The infestation increased annually through 1974, with the exception of infestation on National Forest lands where number of infested trees decreased from 1972 to 1973, then increased sharply in 1974. In 1973 and 1974, ponderosa pine, *Pinus ponderosa* Laws, were also attacked. By 1974, population had reached epidemic proportion on 1,853 acres of U.S. Forest Service, U.S. Plywood, and Burlington Northern Railroad lands (Fig. 1).

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1/ Montana Department of Natural Resources and Conservation, Division of Forestry, Missoula, Montana.

Several factors that may have contributed to buildup of the infestation to epidemic levels are:

1. Stand age: Lodgepole pine in these drainages are mature, 100 years old, with about 5 percent of the stems being overmature. 2/

2. Stand density: Stocking levels average 240 trees/acre. Competition between trees could have resulted in moisture stress.

3. Climate: Dry weather conditions that prevailed during 1973 and 1974 may have imposed additional stress on the stand, thus predisposing trees to beetle attack.

Because of timber already killed, and potential threat to adjacent lodgepole and ponderosa stands, the Lolo National Forest, Burlington Northern Railroad Company, and U.S. Plywood Corporation requested a biological evaluation to obtain estimates of numbers of trees killed and volume loss by year from 1972 through 1974, and determine potential for additional loss.

METHODS

Ground surveys were conducted on 1,853 acres of land owned by the U.S. Forest Service, Burlington Northern Railroad Company, and U.S. Plywood Corporation during February and March 1975. Variable plots (BA=10) were established at 5-chain intervals on cruise lines 5 chains apart. Spiegal Relaskops were used to tally trees in each plot. Data were taken according to FSM 5200 R-1 Supplement No. 8, July 1972.

In addition, twenty 1/10-acre plots were taken on a systematic grid pattern at 5-chain intervals to obtain a stand profile of phloem thickness for each lodgepole pine diameter class.

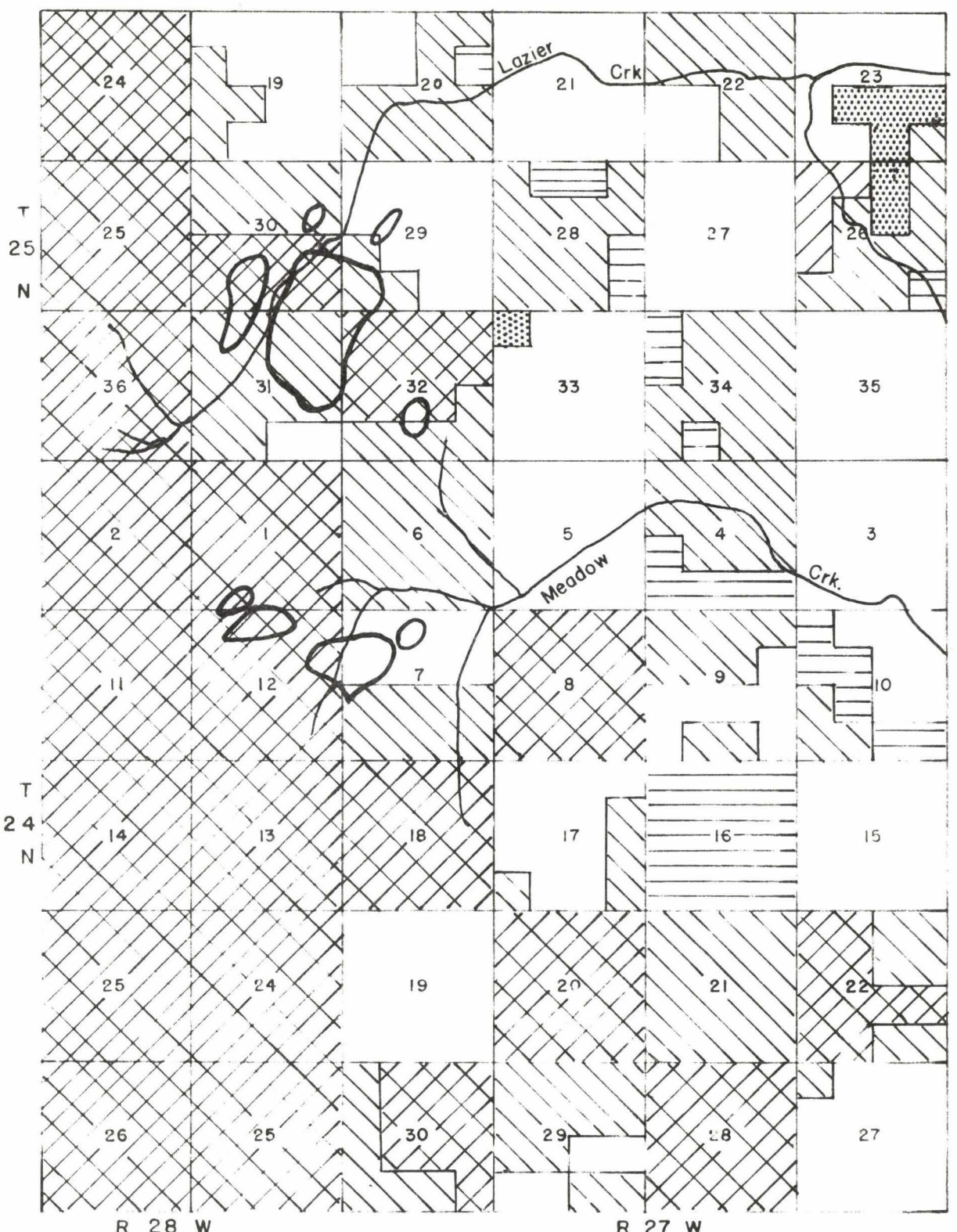
At each plot, a hypsometer was used to determine if trees fell within the plot boundary, then two phloem samples were removed from opposite sides of two trees, 5 inches d.b.h. and larger in each diameter class. Phloem samples were measured to the nearest one-hundredth of an inch with a steel ruler. Survey data were analyzed using a modified R-1 timber sale cruise program.

RESULTS

STAND DESCRIPTION.--Habitat types (Pfister et al. 1974) in the Lazier-Meadow Creek drainages are *Abies grandis/Xerophyllum tenax* and *Abies lasiocarpa/Clintonia uniflora*. Climax type varies from larch-lodgepole pine to Douglas-fir at lower elevations changing to subalpine-grand fir in wetter draws and at higher elevations.

2/ Personal communication, Douglas Shaner, Plains Ranger District, Lolo National Forest, 1975.

Figure 1. Mountain Pine Beetle Infestation, Lazier-Meadow Creek Drainages, 1975.



Green stands in areas surveyed consisted of:

lodgepole pine, *Pinus contorta* Dougl., 70.4%
western larch, *Larix occidentalis* Nutt., 12.7%
Douglas-fir, *Pseudotsuga menziesii* var *glauca* (Beissn.) Franco, 10.2%
subalpine fir, *Abies lasiocarpa* (Hook.) Nutt, 1.2%
grand fir, *Abies grandis* (Dougl.) Lindl, 1.1%

The remaining 0.3% was western white pine, *Pinus monticola* Douglas; Engelmann spruce, *Picea engelmannii* Parry; and narrowleaf cottonwood, *Populus angustifolia* James. Site index is classed 60 to 65 and considered a good site for growing mixed species such as larch, lodgepole pine, and Douglas-fir.

INFESTATION INTENSITY.--A total of 118,486 trees were killed with an estimated 5,666,124 board foot volume loss (Table 1). Of this, 1,475 ponderosa pine were killed with a volume loss of 118,173 board feet.

Table 1.--Mountain pine beetle tree and volume loss estimates, Lazier and Meadow Creek drainages, Lolo National Forest, Burlington Northern, and U.S. Plywood lands, 1972-1974.

Year	Av. d.b.h.	Trees killed /acre	Total trees killed	Vol.loss/ac. (board feet)	Total vol. loss (board feet)
		LOLO NATIONAL FOREST			
1972	8.0	15.9	14,383	794	718,347
1973	9.0	13.1	12,460	776	702,436
1974	8.0	43.7	40,136	1,814	1,641,085
Total or average	8.3	72.7	66,979	3,384	3,061,868
		BURLINGTON NORTHERN RAILROAD			
1972	9.0	8.5	5,752	449	305,139
1973	9.0	16.3	11,097	887	603,255
1974	9.0	25.6	17,421	1,302	885,660
Total or average	9.0	50.4	34,270	2,638	1,794,054
		U.S. PLYWOOD			
1972	9.0	14.6	3,907	754	202,075
1973	8.0	20.7	5,652	912	244,434
1974	8.0	27.9	7,678	1,357	363,693
Total or average	8.3	63.2	17,237	3,023	810,202
Grand total			118,486		5,666,124

Buildup ratios of old to newly attacked trees were 1:1.2 from 1972 to 1973, and 1:2.2 from 1973 to 1974.

Stand reduction from 1972 to 1974 averaged nearly 30% (Table 2).

Table 2.--Percent stand reduction by mountain pine beetle, Lazier-Meadow Creek infestation, 1972 through 1974

Year	U.S. Forest Service	U.S. Plywood	Burlington Northern
1972	6.2	6.3	3.6
1973	5.7	9.5	7.3
1974	19.4	14.6	12.4
	31.3	30.4	23.3

Infested trees averaged 8.3 inches d.b.h. in 1972, 9 inches d.b.h. in 1973, and 8.3 inches d.b.h. in 1974 (Table 1).

In 1972, 20.7% of all trees killed were 12 inches d.b.h. and larger; 18.8% were 12 inches d.b.h. and larger in 1973; and 10.5% were 12 inches d.b.h. and larger in 1974 (Table 3).

Table 3.--Number and percent of infested trees by diameter class, Lazier-Meadow Creek drainages, Plains District, Lolo National Forest, 1972-74

	Size classes (inches at d.b.h.)															
Year	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18+	Total
1972	9	16	25	47	58	70	33	28	17	15	4	3	1	--	--	326
Percent	2.7	4.9	7.6	14.4	17.7	21.4	10.1	8.5	5.2	4.6	1.2	0.9	0.3	--	--	--
1973	7	16	53	85	69	95	47	37	14	19	6	5	3	3	1	460
Percent	1.5	3.4	11.5	18.4	15.0	20.6	10.2	8.0	3.0	4.1	1.3	1.0	.6	.6	.2	--
1974	24	65	185	196	153	125	65	36	22	18	9	4	3	4	3	912
Percent	2.6	7.1	20.2	21.4	16.7	13.7	7.1	3.9	2.4	1.9	.9	.4	.3	.4	.3	--
Remaining green stand	385	476	463	365	257	205	93	63	30	33	10	3	3	6	3	2,395
Percent	16.0	19.8	19.3	15.2	10.7	8.5	3.8	2.6	1.2	1.3	.4	.1	.08	.2	.1	--

Phloem thickness of infested trees sampled ranged from 0.03 to 0.14 inch (Table 4). Of all infested trees measured, 10.0% had a phloem thickness greater than or equal to 0.10 inch. Some infested trees down to as small as 5 inches d.b.h. had phloem greater than or equal to 0.10 inch thick.

Table 4.--Phloem thickness measurement of infested lodgepole pine, Lazier-Meadow Creek mountain pine beetle infestation.

D.b.h.	Range	Mean	Standard deviation	Standard error
5	0.03-.10	0.059	0.022	0.005
6	.04-.10	.066	.016	.002
7	.03-.11	.072	.017	.002
8	.04-.14	.074	.021	.003
9	.04-.13	.077	.019	.003
10	.03-.13	.080	.022	.004
11	.04-.11	.085	.020	.005
12	.06-.10	.083	.014	.004
13	--	--	--	--
14	.09-.14	.180	.024	.012

Results of phloem measurements from the residual green trees are shown in Table 5.

Table 5.--Phloem thickness of the residual green stand, Lazier-Meadow Creek mountain pine beetle infestation, 1974.

D.b.h.	Range	Mean	Standard deviation	Standard error
5	0.02-.11	0.058	0.022	0.003
6	.03-.14	.068	.023	.003
7	.02-.14	.071	.021	.003
8	.04-.14	.078	.020	.003
9	.03-.10	.073	.022	.006
10	.03-.15	.084	.034	.012
11	--	--	--	--
12	.09-.15	.113	.026	.013

In the remaining green stand within the survey area, approximately 6% of the trees are 12 inches d.b.h. and larger; and all have phloem greater than or equal to 0.10 inch thick. Phloem measurements range from 0.02 to 0.15 inch thick. Some trees in all diameter classes down to and including 5 inches d.b.h. have phloem greater than or equal to 0.10 inch thick. However, of all phloem samples taken from green trees, 9.5% had an average phloem thickness greater than or equal to 0.10 inch thick. Remaining green stand still contains a significant proportion of lodgepole pine (Table 6).

Table 6.--Percent of residual green stand by species by ownership, Lazier-Meadow Creek mountain pine beetle infestation, 1974.

Tree species	National Forest	Burlington Northern	U.S. Plywood
Lodgepole pine	74.9	75.6	60.8
Western larch	11.5	10.6	16.2
Douglas-fir	10.3	9.0	11.3
Ponderosa pine	1.3	1.2	8.1
Other	1.4	3.3	3.6

DISCUSSION

Mountain pine beetle first infested 100-year-old lodgepole pine stands in Lazier and Meadow Creek drainages on the Plains District in 1971. Mature, overstocked stands and weather conditions were favorable for outbreak development to epidemic levels. Infestations usually develop in stands 80 years and older containing trees 10 inches d.b.h. and larger. Under favorable conditions such as these, stand depletion increases 4 to 9% with each increase in tree diameter above 6 inches d.b.h. (Safranyik et al., 1974). Outbreaks will continue at epidemic levels until the large diameter trees and those with thick phloem are killed, resulting in average diameter component of the residual stand usually below 8 inches d.b.h. The Lazier-Meadow Creek infestation increased from 24,042 infested trees in 1972, to 29,209 in 1973, then increased to 65,235 in 1974. Total volume loss was 5,666,124 board feet from 1972 to 1974. Number of infested trees per acre did not change appreciably from 1972 to 1974. During this 3-year period, 31% of the stand was killed on National Forest lands; 30% on U.S. Plywood ownership; and 23% on Burlington Northern lands.

Various factors such as: (1) phloem thickness, (2) tree diameter, (3) stand density, (4) age, (5) habitat type, and (6) weather conditions directly influence beetle population which, in turn, affect number of trees killed during a mountain pine beetle outbreak (Cole, 1973; Safranyik et al., 1974). Data from past epidemic infestations show that the mountain pine beetle selects and attacks larger diameter trees yearly and throughout the continuance of the infestation (Gibson, 1943; Hopping and Beall, 1948; Cole and Amman, 1969; Safranyik et al., 1974). Data collected from this infestation show that although number of trees killed yearly in the larger diameter class increased, the percent of trees killed, 12 inches d.b.h. and larger, decreased yearly as the infestation progressed.

At the same time, number and percent of trees killed yearly increased 10% from 1972 through 1974. This is probably due to the fact that many trees 12 inches d.b.h. and less in size have phloem greater than or

equal to 0.10 inch thick. Also, the majority of the remaining stand (92.2%) is less than 12 inches in diameter. Reid (1963) observed that beetle survival increased with tree diameter. Data from the Lazier and Meadow Creek infestation shows that as this infestation progressed, number of trees killed 12 inches d.b.h. and smaller increased yearly.

Amman (1969) concluded from his studies that when optimum conditions are favorable for beetle development, phloem thickness is the principal factor regulating brood production of the mountain pine beetle in lodgepole pine stands. Also, brood production is positively correlated with phloem thickness and phloem thickness is positively correlated with tree diameter (Amman 1969, 1972). Cole and Cahill (In Press) concluded from studies in Colorado that the correlation of phloem thickness over tree diameter becomes an effective measurement for evaluating infestation potential in a stand. Amman (In Press) also found that beetle survival would be higher in thick than in thin phloem trees because food is more accessible, and beetle larvae are not as likely to encounter each other resulting in intraspecific mortality.

In the Lazier-Meadow Creek infestation, all diameter classes down to and including 5 inches d.b.h. contain trees with phloem greater than or equal to 0.10 inch thick. However, only 9.5% of all green trees measured fall in this category. In samples taken, all trees 12 inches d.b.h. and larger had phloem 0.10 inch thick. By lowering a salvage cut to include trees 10 inches d.b.h., the susceptible component in the stand would only be reduced 24.9%. By lowering the cut to include all trees 8 inches d.b.h. and larger, the susceptible component in the stand would be reduced 50%; and if all trees 5 inches d.b.h. and larger are removed, 100% of the susceptible host component would be removed.

Since the susceptible host component, based on phloem thickness, makes up only 9.5% of the stand, it can be assumed that stand density, age, and composition are probably important factors influencing susceptibility. Stand density was probably influenced by dry weather conditions during 1973-74.

Based on buildup ratios from 1972 to 1974, and on the formula:

Y^1 = y + bx (Baker, 1968) where
Y^1 = the potential cumulative number of trees predicted to be killed through next year (1975)
y = the cumulative number of trees killed through this year (1974)
x = number of trees killed this year (1974)
x_1 = number of trees killed last year (1973)
$b = \frac{x}{x1}$

it is predicted that through 1975, 263,960 trees will be killed, of which 145,474 will be killed during 1975. The predicted number of trees that would be killed through 1974 was 98,301; actual was 118,486, a difference of 20,185 trees.

As logging or beetles remove susceptible trees--those with 0.10 inch thick phloem and greater--from the stand, the infestation should decline. Based on diameter distribution within this stand, a sufficient number of large diameter trees do not exist to maintain the outbreak at its present increasing status. However, sufficient trees with 0.10 inch thick and greater phloem, combined with dense, nearly pure, mature stands and the fact that adjacent uninfested stands are available to provide host material, indicate a continuance of the present epidemic resulting in an increased number of trees being killed in 1975.

RECOMMENDATIONS

Management alternatives available for mountain pine beetle suppression in this area are:

1. Do nothing. Let infestation run its course.

2. Chemical control. Fell infested trees and treat with ethylene dibromide 56 percent concentrate, one part solution to 19 parts diesel oil; or lindane, generally obtained as a 20 percent emulsifiable concentrate mixed with fuel oil in a ratio of one part concentrate to 14 parts oil.

3. Fell and burn infested trees.

4. Silvicultural practices.

    a. Salvage log infested trees.

    b. Selectively log to remove infested trees and that component of the stand 5 inches d.b.h. and larger containing phloem greater than or equal to 0.10 inch thick.

    c. Seed trees cut to leave desired crop trees of mixed species.

Applied suppression (chemical or felling and burning) is not recommended. Both methods have had limited success, and serve only as delaying actions and do not lessen stand susceptibility. Amman and Baker (1972) determined that beetle populations decline in approximately the same number of years in both treated and untreated stands.

Salvage logging only infested trees will not alter susceptibility of the stand to beetle attack. Based on data available, salvage logging to remove all lodgepole pine down to and including the 5-inch d.b.h. size class, and converting to a mixed stand based on habitat type will probably alter the course of the epidemic.

Because of the high probability of the epidemic continuing in adjacent stands in Lazier and Meadow Creek drainages and those along the Thompson

River drainage, it is sound policy to consider planned harvesting of lodgepole pine stands between 80 and 100 years old. Safranyik et al. (1974) indicated that setting rotation age and projecting wood requirements should take into account probability of mountain pine beetle infestation and resulting severe stand depletion. In areas of high stand susceptibility, gains made by allowing longer rotations are probably offset due to beetle-caused losses. Fire hazard is also increased within beetle-infested stands. Priority cutting should be given older stands with large diameter trees.

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